

**WHAT IS CLAIMED:**

1. A communications node in a network including a plurality of nodes, said communications node including a transceiver to transmit and receive messages and having at least one communications link with a first node of the plurality of nodes, said communications node comprising:

an electronic memory circuit having network information stored therein; and

an electronic processor circuit which (i) determines path loss information across the at least one communications link by evaluating power data corresponding to a message received from the first node; (ii) distributes the path loss information to the network; and (iii) routes messages to the network based on path loss information.

2. A communications node according to Claim 1, wherein the power data comprises a received signal strength indication (RSSI).

3. A communications node according to Claim 2, wherein said electronic processor circuit determines the path loss by subtracting the RSSI from a predetermined maximum power.

4. A communications node according to Claim 3,  
wherein said electronic processor circuit determines a  
minimum power level for transmission to the first node.

5. A communications node according to Claim 1,  
5 wherein the power data comprises a received power signal.

6. A communications node according to Claim 1,  
wherein the message from the first node comprises a power  
transmission level and said electronic processor circuit  
determines the path loss based at least in part on the power  
10 transmission level.

7. A communications node according to Claim 6,  
wherein said electronic processor circuit determines a  
minimum power level for transmission to the first node.

8. A communications node according to Claim 1,  
15 wherein the network includes a plurality of communication  
links among the plurality of nodes, and said network  
information comprises path loss data associated with each of  
the communication links.

9. A communications node according to Claim 8,  
20 wherein said electronic processor circuit routes a message  
through the network to a destination node via a route having  
a lowest path loss.

10. A communications node according to Claim 1,  
wherein the network information stored in said electronic  
memory circuit comprises trace records.

11. A communications node according to Claim 10,  
5 wherein said trace records are opaque with respect to said  
communications node.

12. A communications node according to Claim 10,  
wherein the trace records comprise operating parameters for  
the transceiver.

10 13. A communications node according to Claim 12,  
wherein said electronic processor circuit i) accesses the  
trace records through standardized software library calls  
via predefined common sets of names; and ii) uses  
predetermined software for internally manipulating  
15 predetermined trace records.

14. A method of operating a communications node  
in a network including a plurality of nodes, the  
communications node including a transceiver to transmit and  
receive messages, the communications node having at least  
20 one communications link with a first node of the plurality  
of nodes, said method comprising the steps of:

determining path loss information across the at  
least one communications link by evaluating power data  
corresponding to a received signal from the first node;

distributing the path loss information to the  
5 network; and

routing messages to the network based on path loss  
information.

15. A method according to Claim 14, wherein the  
power data comprises a received signal strength indication  
10 (RSSI).

16. A method according to Claim 15, wherein the  
path loss is determined by subtracting the RSSI from a  
predetermined maximum power.

17. A method according to Claim 16, further  
15 comprising the step of determining a minimum power level for  
transmission to the first node.

18. A method according to Claim 14, wherein the  
power data comprises a received power signal.

19. A method according to Claim 14, wherein the  
20 received signal from the first node comprises a power  
transmission level, and said method further comprises the

step of determining the path loss based at least in part on the power transmission level.

20. A method according to Claim 19, further comprising the step of determining a minimum power level for transmission to the first node.

21. A method according to Claim 14, wherein the network includes a plurality of communication links among the plurality of nodes, and said method further comprises the step of storing path loss data associated with at least one of the communication links.

22. A method according to Claim 21, further comprising the step of routing a message through the network to a destination node via a route having a lowest path loss.

23. A method of conserving energy in a wireless ad-hoc network, the network comprising a plurality of communication nodes, each node including a transmitter and receiver, the network including a plurality of communication links between the nodes, said method comprising the steps of:

determining energy attenuation data for messages transmitted over the links;

distributing the energy attenuation data to the  
communication nodes; and

determining a network routing path comprising a  
lowest energy path and routing a message via the lowest  
5 energy path.

24. A method of conserving energy in a wireless  
ad-hoc network, the network comprising a plurality of  
communication nodes, each node including a transmitter and  
receiver, the network including a plurality of communication  
10 links between the nodes, said method comprising the steps  
of:

determining a minimum transmission level for each  
of the links;

distributing the minimum transmission levels to  
15 the communication nodes; and

determining a network routing path comprising a  
lowest energy path based on the minimum transmission levels  
and routing a message via the lowest energy path.

25. In a communications system for communication  
20 in a network having a plurality of nodes, each node  
including transmitting and receiving means, the network  
including a plurality of communication paths among the

nodes, a method of operating a network comprising the steps of:

determining an energy requirement for each of the plurality of communication paths;

5 selecting a communications path having a lowest energy requirement to route a message; and

routing the message via the selected communications path.

26. The method according to Claim 25, wherein the  
10 energy requirement comprises path loss data.

27. The method according to Claim 25, wherein the energy requirement comprises a transmission power level.

28. In a communications system for communication in a network having a plurality of nodes, each node  
15 including transmitting and receiving means, the network including a plurality of paths among the nodes, each path comprising at least one communications link, a method of operating a network comprising the steps of:

estimating an energy requirement across each of  
20 the communications links;

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distributing the energy requirements to the plurality of nodes;

routing a message over a selected communications path, the path being selected based on a total energy requirement of the path.

29. The method according to Claim 28, wherein the selected path has the lowest total energy requirement.

30. The method according to Claim 28, wherein the energy requirement comprises path loss data.

10 31. The method according to Claim 28, wherein the energy requirement comprises a transmission power level.

32. Computer executable code stored on a computer readable medium, the code to operate a communications router in a communications network, the network including a plurality of communication routers and a plurality of communications links, said code comprising:

code to determine energy information associated with at least some of the plurality of communication links;

code to distribute the energy information to at least some of the routers; and



code to determine a network routing path having a lowest energy based at least in part on the energy information.

33. A communications node in a network including  
5 a plurality of nodes, said communications node including a transceiver to transmit and receive messages, said communications node having at least one communications link with a first node of the plurality of nodes, said communications node comprising:

10 means for storing network information;

means for determining a path loss across the at least one communications link by evaluating power data corresponding to a message received from the first node;

15 means for distributing the path loss information to the network; and

means for routing messages to the network based on path loss information.

34. A method of operating a communications router  
in an ad-hoc wireless network including a plurality of  
20 routers, the method comprising the steps of:

determining a power level requirement for a  
5 message transmission between the communications router and  
the first router by subtracting the RSSI from a transmission  
power level of the first router; and

10                    35.    A method according to Claim 34, wherein the  
power level of the first router is a predetermined power  
level.

36. The method according to Claim 34, wherein the  
power level of the first router is provided in the message  
15 from the first router.

receiving power level requirements from the plurality of network nodes; and

20            selecting routing paths based on the power level  
             requirements so as to minimize a network energy expenditure.

38. A method of estimating instantaneous minimum transmission power to close a link in a wireless network between a first node and a second node of a plurality of communication nodes with each node including transmitting means and receiving means, said method comprising the steps of:

monitoring by the first node, transmission signals from at least the second node in the network;

filtering energy data corresponding to the transmission signal with a linear predictive filter; and

outputting from the linear predictive filter a signal corresponding to a transmission energy requirement.

39. A method according to Claim 38, wherein the energy data is a received signal strength indicator.

40. A method according to Claim 38, wherein the energy data is a received power level.

41. A method according to Claim 38, wherein the energy data is path loss data.

42. A method according to Claim 38, wherein the energy requirement is a minimal transmit power level to transmit a signal from the first node to the second node.

43. A method according to Claim 38, further comprising the step of distributing the energy requirement to the plurality of nodes.

44. A method according to Claim 38, wherein the  
5 transmission signals monitored by the first node comprise side information.

45. A method according to Claim 38, wherein the side information comprises data received from a third node of the plurality of nodes.

10 46. A communications node for estimating instantaneous minimum transmission power to close a link in a wireless network between said communications node and a first node of a plurality of communication nodes with each node including transmitting means and receiving means, said  
15 apparatus comprising:

means for monitoring transmission signals from at least the first node in the network; and

means for filtering energy data corresponding to the transmission signal, and for outputting a signal  
20 corresponding to a transmission energy requirement.

47. A communications node according to Claim 46,  
wherein the monitored transmission signals comprise side  
information.

48. A communications node according to Claim 47,  
5 wherein the side information comprises data received from a  
second node in the network.

49. A method of routing signals in a network, the  
network including a plurality of members, each member  
adapted to transmit and receive signals, said method  
10 comprising the steps of:

receiving at a first member of the plurality of  
members a signal transmitted from a second member of the  
plurality of members;

determining power data corresponding to the  
15 received signal;

calculating a transmission power level for  
transmitting a signal from the first member to the second  
member based at least in part on the power data;

distributing the transmission power level to at  
20 least some of the plurality of members; and

routing messages based at least in part on  
distributed transmission power levels.

50. The method according to Claim 49, wherein the power data includes a received power level signal.

51. The method according to Claim 49, wherein the power data includes a received signal strength indicator.

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